Electronic TUBES

5965

TWIN TRIODE

Five-Star Tube
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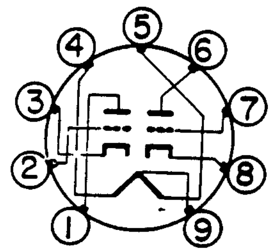
FOR COMPUTER APPLICATIONS

SHARP-CUTOFF CHARACTERISTIC HIGH PERVEANCE

DESCRIPTION AND RATING

The 5965 is a miniature twin-triode primarily designed for service in computer applications. Each triode section features a high zero-bias plate current, a sharp-cutoff characteristic, and a separate cathode connection. In addition, the balance of the cutoff characteristic between the two sections is controlled. When used in "on-off" control applications, the 5965 will maintain its emission capabilities after long periods of operation under cutoff conditions. The heater-cathode construction of the tube is designed for dependable service under conditions of intermittent operation.

BASING DIAGRAM



EIA 9A

TERMINAL CONNECTIONS

Pin 1—Plate (Section 2)
Pin 2—Grid (Section 2)
Pin 3—Cathode (Section 2)
Pin 4—Heater
Pin 5—Heater
Pin 6—Plate (Section 1)
Pin 7—Grid (Section 1)
Pin 8—Cathode (Section 1)
Pin 9—Heater Center Tap

GENERAL

ELECTRICAL

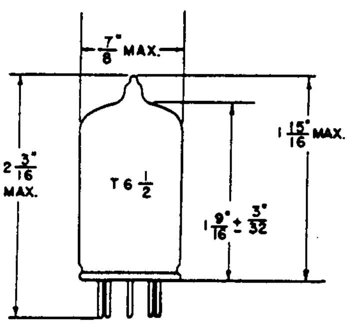
	Series	Parallel	
Cathode—Coated Unipotential			
Heater Voltage, AC or DC	12.6±5%	6.3±5%	Volts
Heater Current	0.225	0.45	Amperes
Direct Interelectrode Capacitances*			
Grid to Plate, Each Section		3.0	μμf
Input, Each Section		4.0	μμf
Output, Section 1		0.5	μμf
Output, Section 2		0.36	μμf
Heater to Cathode, Each Section		3.6	μμf
Grid to Grid, maximum		0.015	μμf
Plate to Plate, maximum		1.1	μμf

*Without external shield.

MECHANICAL

Mounting Position
Preferred Orientation—Upright or with Plate Majors in Vertical Position
Permissible Orientation—Any
Envelope—T-6½, Glass
Base—E9-1, Small Button 9-Pin

PHYSICAL DIMENSIONS



EIA 6-2

GENERAL ELECTRIC

Supersedes ET-T1159, dated 1-55

MAXIMUM RATINGS

DESIGN-MAXIMUM VALUES, Each Section

Plate Voltage	330	Volts
Peak Positive Pulse Plate Voltage	660	Volts
Positive DC Grid Voltage	0	Volts
Negative DC Grid Voltage	75	Volts
Peak Positive Grid Voltage†	10	Volts
Peak Negative Grid Voltage	200	Volts
Plate Dissipation, each plate	2.2	Watts
Total Plate Dissipation, both plates	4.0	Watts
DC Grid Current	0.5	Milliamperes
Peak Grid Current†	50	Milliamperes
DC Cathode Current	16.5	Milliamperes
Peak Cathode Current†	180	Milliamperes
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode		
DC Component	100	Volts
Total DC and Peak	200	Volts
Heater Negative with Respect to Cathode		
Total DC and Peak	200	Volts
Grid-Circuit Resistance		
With Fixed Bias	0.1	Megohms
With Cathode Bias	0.5	Megohms
Bulb Temperature at Hottest Point	150	C

† Rating based on a pulse of 10-microseconds duration, 1-percent duty cycle, and 1000-cycle repetition rate.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, taking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

AVERAGE CHARACTERISTICS

CLASS A_1 AMPLIFIER, Each Section

Plate Voltage	150	Volts
Grid Voltage	−2.0	Volts
Amplification Factor	47	
Plate Resistance, approximate	6700	Ohms
Transconductance	7000	Micromhos
Plate Current	8.5	Milliamperes

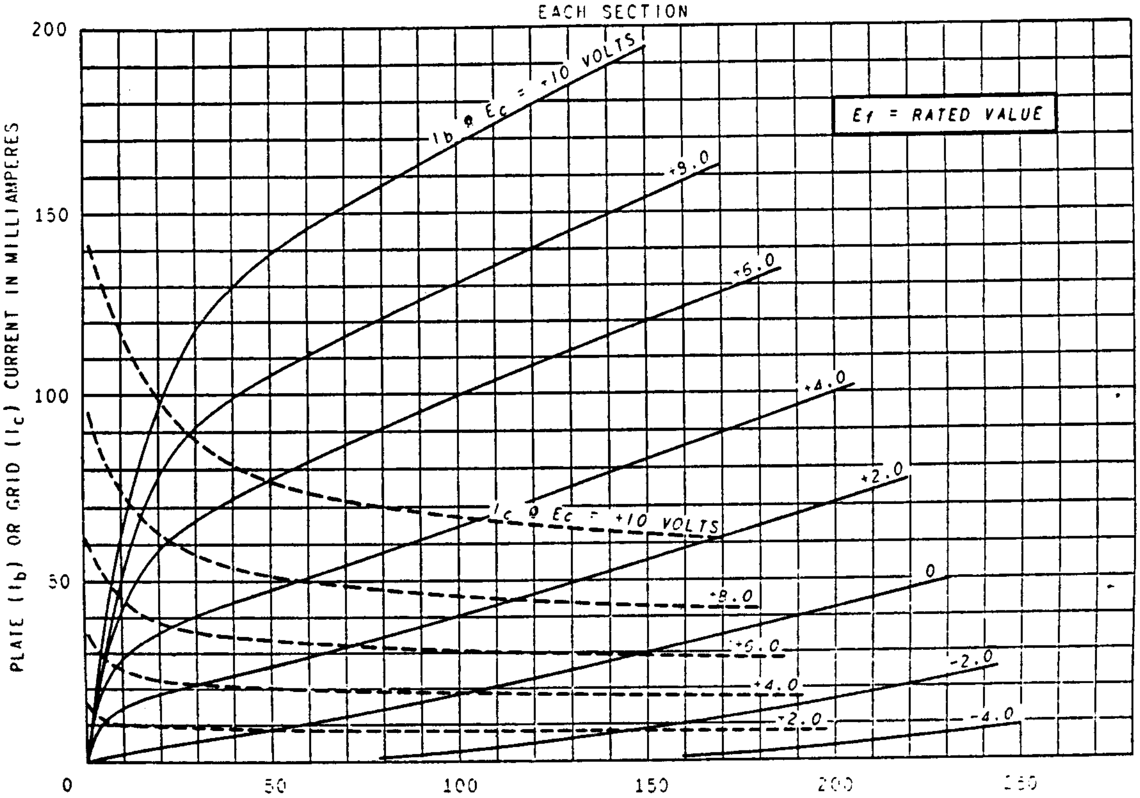
COMPUTER SERVICE, Each Section

Plate Voltage	100	150	Volts
Grid Current‡, approximate	200		Microamperes
Plate Current	17.8		Milliamperes
Grid Voltage, maximum			
Ib = 150 Microamperes	...	−7.5	Volts

‡ Grid tied to +100 volts through 0.5-megohm resistor.

AVERAGE PLATE CHARACTERISTICS

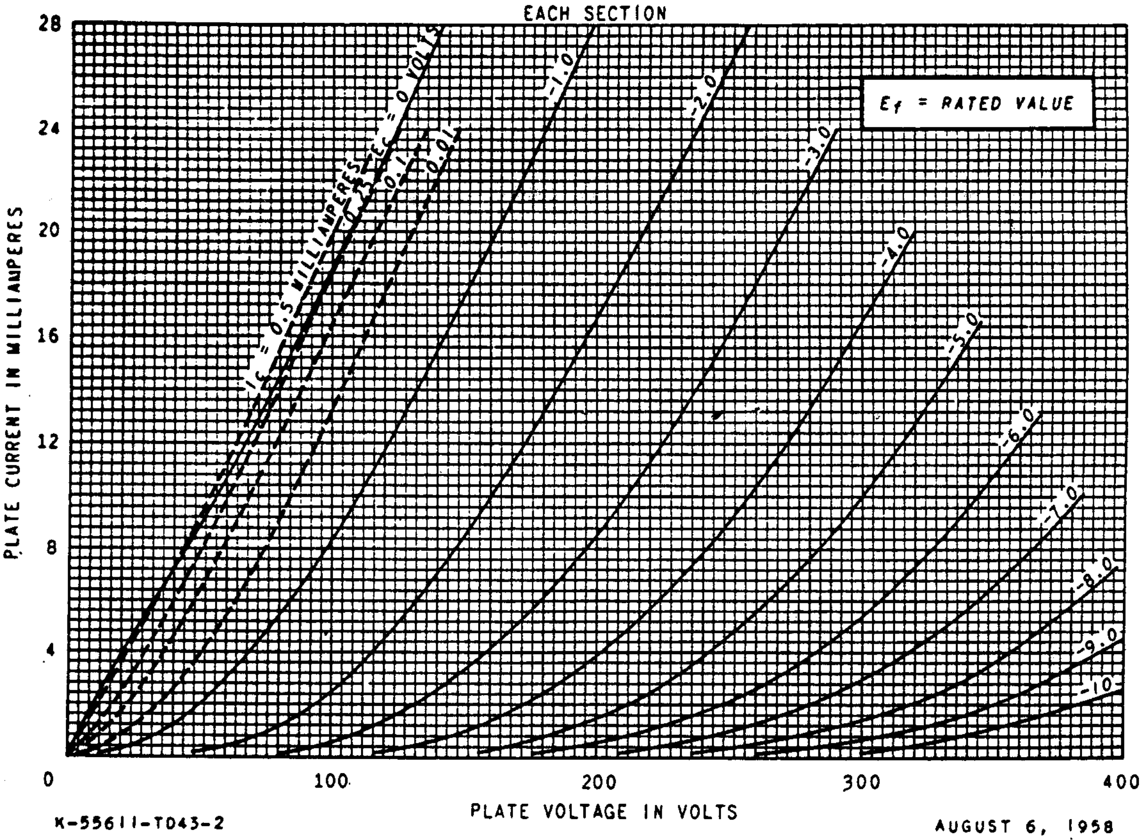
EACH SECTION



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AVERAGE PLATE CHARACTERISTICS

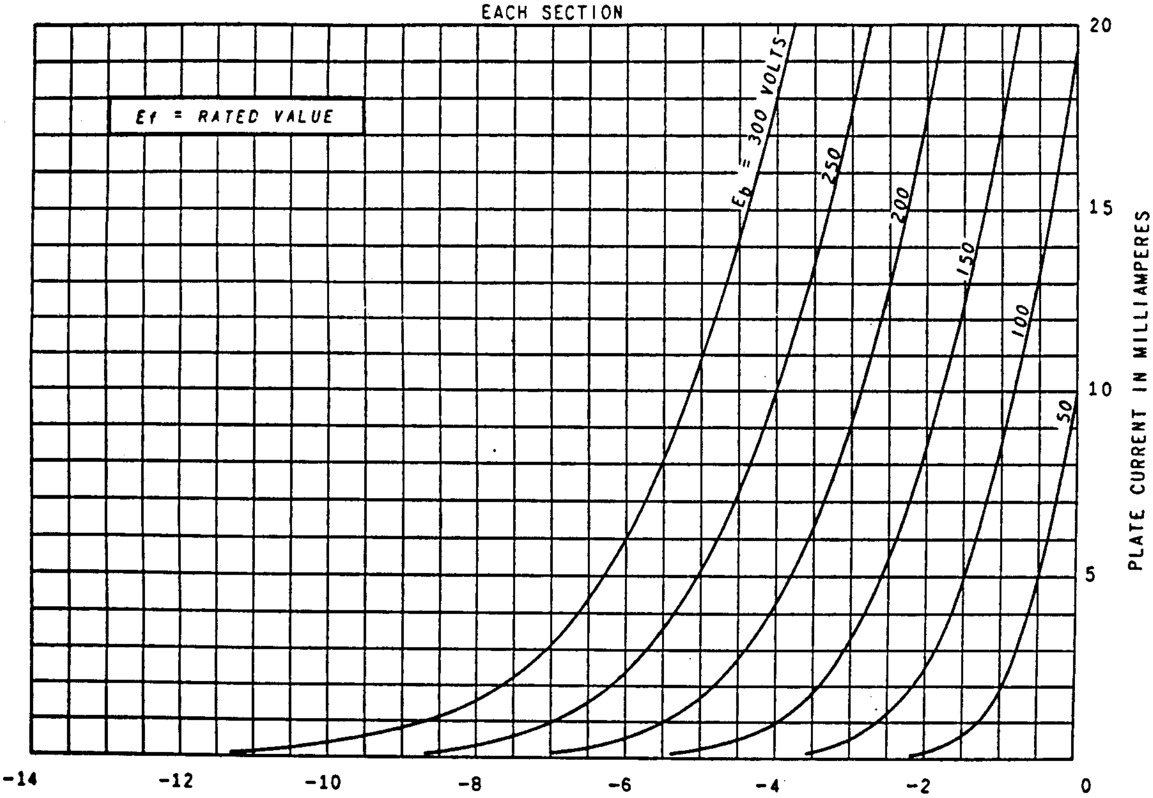
EACH SECTION



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AVERAGE TRANSFER CHARACTERISTICS

EACH SECTION

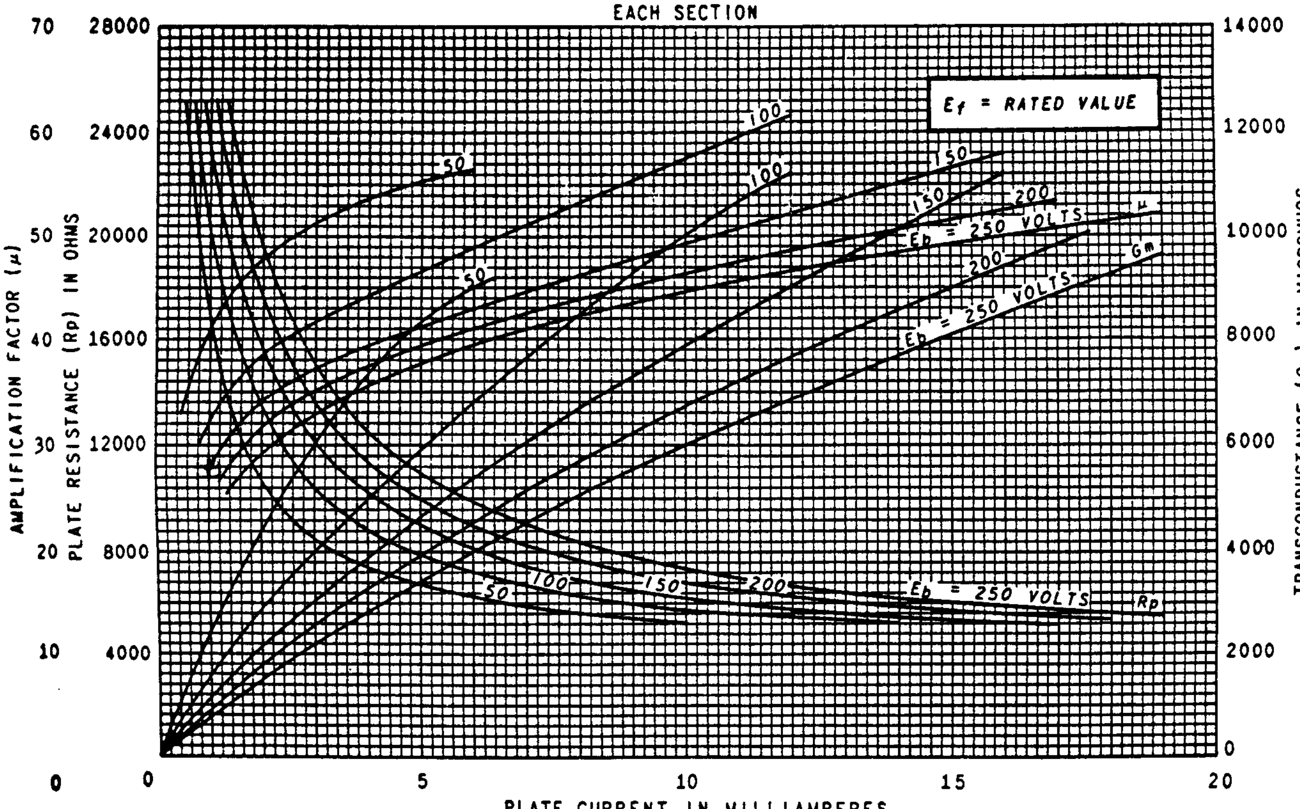


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AVERAGE CHARACTERISTICS

EACH SECTION



K-55611-TD43-4

AUGUST 6, 1958

PERFORMANCE ASSURANCE SPECIFICATION

General Test Conditions

Heater Voltage (Note 1) 6.3V
Plate Voltage 150Vdc
Grid Voltage .... −2Vdc
Heater Cathode Voltage 0V

For the purposes of inspection, use applicable paragraphs of MIL-E-1.

MIL-E-1 Ref.	Test	Modifications to General Test Conditions	AQL %	Insp. Level	Sym.	LIMITS Min.	Bogey	Max.	Units
	Measurements Acceptance Test, Part 1, Note 2								
......	Continuity & Short Circuits: Note 3 (Inoperative)		0.4	II					
4.10.8	Heater Current		0.65	II	If:	415	450	485	mA
4.10.6.1	Grid Current	Rg = 0.1 Meg; Note 4	0.65	II	Ic:	0		−1.0	μAdc
4.10.4.1	Plate Current (1)	Note 4	0.65	II	Ib(1):	4.3	8.5	12.0	mAdc
4.10.5.2	Grid Voltage	Eb = 150Vdc; Ec/Ib = 150μA; Note 4.	0.65	II	Ec:			−7.5	Vdc
4.9.1	Mechanical:								
	Measurements Acceptance Test, Part 2, Note 5								
4.8.2	Insulation of Electrodes: Note 6		2.5	I					
	g-all				IR:	50			Meg
	p-all					50			Meg
4.10.15	Heater-Cathode Leakage	Ehk = ±100Vdc	2.5	I	Ihk:	0		20	μAdc
4.10.4.1	Plate Current (2)	Eb = 100Vdc; Ic = 200μA; Note 4	2.5	I	Ib(2):	13.6	17.8	22.0	mAdc
4.10.9	Transconductance	Note 4	2.5	I	Sm(1):	5000	7000	9000	μmhos
	Measurements Acceptance Test, Part 3								
4.10.9	Transconductance	Ef = 5.7V	6.5	L6	Sm(2):	4000			μmhos
4.10.6.2	Grid Emission	Ef = 7.0V; Eb = 150Vdc; Ecc = −20 Vdc; Rg/g = 0.1 Meg; Notes 4 and 7	6.5	L6	Isc:			−2.0	μAdc
4.10.5.2	Bias Balance	Eb = 150Vdc; Ec/Ib = 150μAdc; Note 8	6.5	L6	ΔEc:			2.0	Vdc

MIL-E-1 Ref.	Test	Modifications to General Test Conditions	AQL %	Allowable Defects per Characteristic 1st Sample	Combined Sample	Sym.	LIMITS Min.	Max.	Units
	Acceptance Life Tests								
4.11.7	Heater Cycling Life Test	Ef=7.5; Ehk=+135; Ec=Eb=0	1.0						
4.11.4	Heater Cycling Life Test End Points	Open Elements; Note 9							
		Heater-Cathode Leakage							
		Ehk=+100				Ihk:		60	μAdc
		Ehk=−100				Ihk:		60	μAdc
......	Class A Life Test	Eb=150Vdc; Rk/k=39; Ehk=+100; Rg/g=0.1 Meg Rb/p=1600; Note 10 and 11				t:	1000		hr
4.11.4	Class A Life Test End Points	Inoperatives, Note 12		1	2				
		Grid Current		1	2	Ic:		−1.5	μAdc
		Plate Current (1)		1	2	Ib(1):	3.5		mAdc
		Plate Current (2), Note 13		2	3	Ib(2):	11.4		mAdc
		Heater-Cathode Leakage		2	3				
		Ehk=+100				Ihk:		30	μAdc
		Insulation Resistance		2	3	IR:	10		Meg
		Grid Emission, Note 14		1	2	Isc:		−4.0	μAdc
		Interface Resistance, Note 15 Ef=5.7Vdc; Eb=100Vdc; Ec/Ib=2.5 mAdc		1	2	Ri:		25	ohm
		ΔAvg Ib(1); Note 16						−20	%
		Total Defectives		3	5				
......	Cut-Off Life Test	Eb=150Vdc; Ecc=−100; Ehk=−100; Rg/g=0.1 Meg; Rk/k=15000; Note 10 and 11				t:	1000		hr
4.11.4	Cut-Off Life Test End Points	Inoperatives, Note 12		1	2				
		Grid Current		1	2	Ic:		−1.5	μAdc
		Plate Current (1)		1	2	Ib(1):	3.5		mAdc
		Plate Current (2), Note 13		2	3	Ib(2):	11.4		mAdc
		Heater-Cathode Leakage		2	3				
		Ehk=−100				Ihk:		30	μAdc
		Insulation Resistance		2	3	IR:	10		Meg
		Grid Emission, Note 14		1	2	Isc:		−4.0	μAdc
		Interface Resistance, Note 15 Ef=5.7Vdc; Eb=100Vdc; Ec/Ib=2.5 mAdc		1	2	Ri:		25	ohm
		Total Defectives		3	5				
......	Zero-Bias Life Test	Eb=150Vdc; Rb/p=6800; Rg/g=1.1 Meg (Note 17); Note 18				t:	1000		hr
4.11.4	Zero-Bias Life Test End Points	Plate Current (3) Eb=150Vdc; Rb/p=6800; Rg/g=1.1 Meg (Note 17)		1	2	Ib(3):	9.0		mAdc

Note 1: Tie heaters in parallel.

Note 2: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical, shall be 1.0 percent. A tube having one or more defects shall be counted as one defective.

Note 3: Tubes shall be tested for continuity of all circuits, for shorts between tube elements, and for air leaks. During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90 to 120 degrees apart with a tapper, which shall be adjusted to give an impulse of approximately one-half sine wave of 300 ± 50 microseconds duration and having an amplitude equivalent to 80 G's peak acceleration, as measured on the Gulton A-305 accelerometer.

The tube under test shall be connected to the shorts test equipment in such a manner that a specified minimum sensitivity is maintained between all elements in a single section of a tube, but like elements in the sections of a multisection tube may be paralleled, provided the mechanical assembly of the tube structure is such that the possibility of shorts between sections is remote. Except for heater to cathode, a short circuit shall be defined as an equivalent resistance between adjacent elements which persists for a period of time in excess of that determined by a limiting curve of resistance versus time duration passing through the following points: 600,000 ohms, constant value (permanent short); 500,000 ohms, 500 microseconds; 100,000 ohms, 100 microseconds; and 1,000 ohms, 60 microseconds. For heater to cathode, the minimum sensitivity shall be 10% of the above resistance value.

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

(a) Either a permanent or tap short at any time during the tapping procedure.

(b) Any open circuit.

(c) Air leaks as defined by Par. 4.7.6, MIL-E-1.

Note 4: Test each section separately with elements of opposite section grounded.

Note 5: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 2, shall be 4 percent.

Note 6: Measure at a potential of 100 volts grid to all and 300 volts plate to all.

Note 7: Prior to the Grid Emission test (Isc), tube shall be preheated five minutes at conditions indicated below. Test immediately after preheating.

Ef	Ebb	Ecc	Rk/k	Rg/g
V	Vdc	Vdc	ohms	Meg
7.0	150	0	150	0.5

Note 8: Adjust Ecc bias of each section for Ib = 150 μA. Difference in bias between sections shall not exceed the limit specified.

Note 9: A defective for Open Elements as referenced on this test is any tube which shows an open heater or open cathode circuit which occurs at any time during the life test.

Note 10: The test sample shall consist of 20 tubes selected at random for each of the specified life tests. In the event of failure of the first sample, a second sample of 20 tubes shall be selected and life tested. Acceptance shall then be based on combined results from the first and second samples.

Note 11: Operate each section separately with specified Rg in each grid and specified Rk in each cathode.

Note 12: An inoperative as referenced in the life test is as defined in Measurement Acceptance Tests, Part 1, with the exception that any tube which shows an intermittent short-circuit indication during one test cycle shall be tested for 3 additional cycles. Tube which shows a short-circuit indication two or more times during the total four cycles shall be considered a defective. Short-circuit test shall be performed at initial and 1000-hour reading periods only.

Note 13: A decrease in plate current to 25 percent below the initial minimum during the 1000-hour life tests is permissible although the specified 1000-hour life-test end point must be met.

Note 14: The grid emission test shall be performed on the life-test samples after all other specified tests at the initial and 1000-hour reading periods.

Note 15: Interface Resistance shall be read after Continuity and Short-circuit test and before all other tests specified on the life-test samples.

Note 16: The change in the average value of Plate Current (1) characteristic of the total number of samples on Class A life test at 1000 hours must be not greater than 20 percent down from the average value at initial hours.

Note 17: Operate each section separately with specified Rb in each plate and each grid connected to +150 volt supply through a 1.1 megohm resistor.

Note 18: The zero-bias life-test sample shall consist of 10 tubes selected at random. In the event of failure of the first sample, a second sample of 10 tubes shall be selected and life tested. Acceptance shall then be based on combined results of first and second samples.

This specification presents, for the information and guidance of the tube user, inspection criteria used at the plant of manufacture. It is subject to change without notice.